SeaWiFS Lunar Phase Angle Corrections

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1. Introduction

Lunar calibrations are performed one per month when the Moon is at a phase angle of approximately 7°. This phase angle is chosen to maximize the illuminated surface of the Moon while minimizing the opposition effect, i.e., the increase in brightness of sunlight diffusely reflected from a particulate surface near zero phase. Operational considerations have caused the lunar calibrations to occur over a phase angle range of $5° - 10°$. Of the 77 lunar calibrations that have occurred to date, 3 took place at phase angles of less than 6°, 3 took place at phase angles of more than 8°, and the median phase angle is 6.9°.

The change in the overall reflectance of the lunar surface with phase angle is non-Lambertian and arises from both changes in the reflectance of the lunar surface and changes in the area of the lunar surface illuminated by the sun with phase angle.

2. Phase Angle Correction

The SeaWiFS phase angle corrections are are emipircal corrections derived from the lunar radiances normalized for distance and oversampling. For each band, a quadratic function has been fit to the inverse of normalized radiances over a phase angle range of $4° - 11°$. The corrections have the functional form:

$$f_3(\lambda, \alpha) \;=\; \left(p_0(\lambda) \;+\; p_1(\lambda)\,\alpha \;+\; p_2(\lambda)\,\alpha^2\right) \tag{1}$$

where:

α	$\equiv$	phase angle
p_0	$\equiv$	constant term of the correction
p_1	$\equiv$	linear term of the correction
p_2	$\equiv$	quadratic term of the correction
λ	$\equiv$	SeaWiFS band

The fits have been normalized so the corrections have a value of unity at a phase angle of 7°, values less than unity for phase angles less than 7° and values greater than unity for phase angles greater than 7°.

The phase corrections for each band are shown in figures *Band 1-8 Phase Correction*. The scatter in the data arises because 30 of the lunar calibrations occurred before full phase

and 47 of the calibrations occurred after full phase. To reduce the scatter in the data and improve the computation of the phase correction coefficients, libration corrrections were computed for the phase-corrected lunar calibration time series, as discussed in *SeaWiFS Lunar Libration Corrections*. These libration corrrections were applied to the normalized lunar radiances and the phase angle corrections were recomputed. The revised phase corrections for each band are shown in the figures *Band 1-8 Revised Phase Correction*. For each band, the scatter in the data have been significantly reduced by the libration corrections. The revised phase corrections are essentially linear functions of phase angle with small 2^{nd} order terms. The revised phase corrections are used to process the lunar calibration time series.